Cost Behavior: Analysis and Use

Chapter 3

AC202 Managerial Accounting

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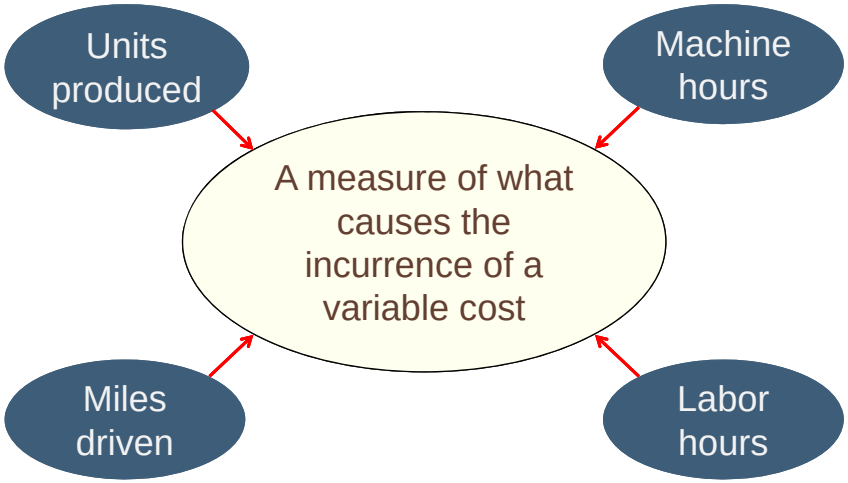
Types of Cost Behavior Patterns

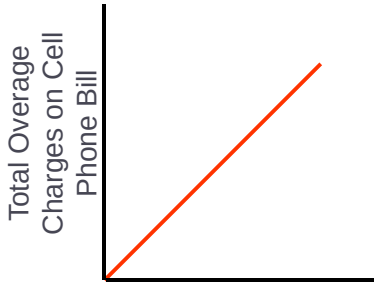
Cost	In Total	Per Unit
Variable	Total variable cost is proportional to the activity level within the relevant range.	Variable cost per unit remains the same over wide ranges of activity.
Fixed	Total fixed costs remain the same even when the activity level changes within the relevant range.	Average fixed costs per unit decrease as the activity level increases.

The Activity Base (also called a cost driver)



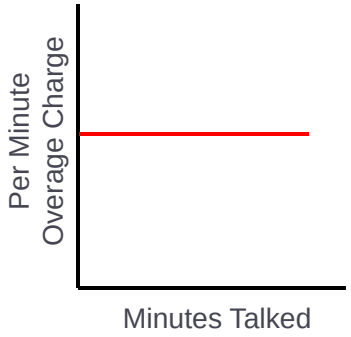
True Variable Cost – An Example

As an example of an activity base, consider overage charges on a cell phone bill. The activity base is the number of minutes used above the allowed minutes in the calling plan.



Variable Cost Per Unit – An Example

Referring to the cell phone example, the cost per overage minute is constant, for example 45 cents per overage minute.



Extent of Variable Costs

The proportion of variable costs *differs* across organizations. For example . . .

A public utility like Florida Power and Light, with large investments in equipment, will tend to have *fewer* variable costs.

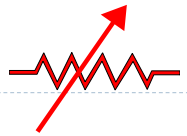
A manufacturing company like Black and Decker will often have *many* variable costs.

Some service companies have *high* variable costs, while other service companies have *high* fixed costs.

A merchandising company like Wal-Mart usually has a *high proportion* of variable costs, like cost of sales.

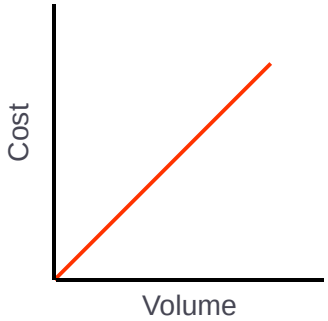
Examples of Variable Costs

1. *Merchandising companies* – cost of goods sold.
2. *Manufacturing companies* – direct materials, direct labor, and variable overhead.
3. *Merchandising and manufacturing companies* – commissions, shipping costs, and clerical costs such as invoicing.
4. *Service companies* – supplies, travel, and clerical.



True Variable Costs

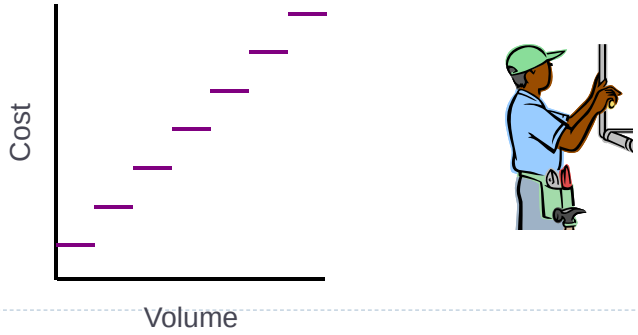
The amount of a true variable cost used during the period varies in direct proportion to the activity level. The overage charge on a cell phone bill was one example of a true variable cost.



Direct material is another example of a cost that behaves in a true variable pattern.

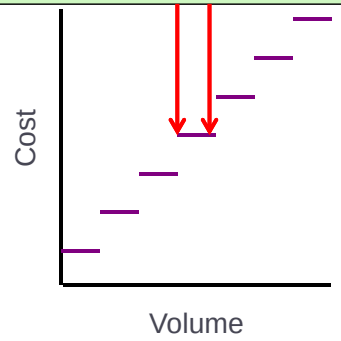
Step-Variable Costs

A *step-variable cost* is a resource that is obtainable only in large chunks (such as maintenance workers) and whose costs change only in response to fairly wide changes in activity.



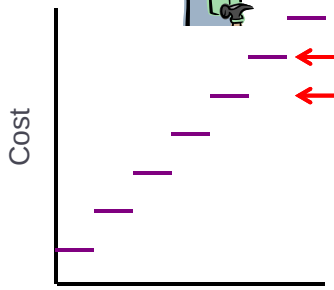
Step-Variable Costs

Small changes in the level of production are not likely to have any effect on the number of maintenance workers employed.

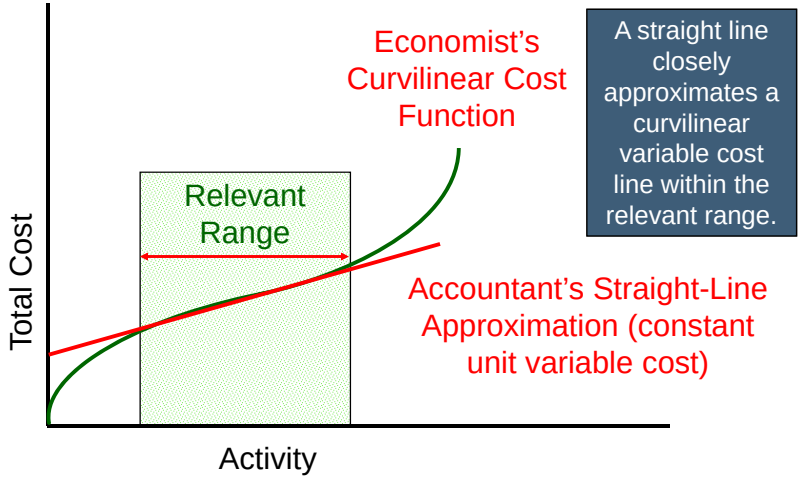


Step-Variable Costs

Only fairly wide changes in the activity level will cause a change in the number of maintenance workers employed.

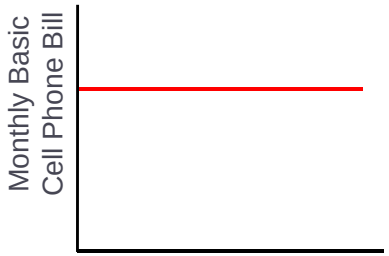


The Linearity Assumption and the Relevant Range



Total Fixed Cost – An Example

For example, your cell phone bill probably includes a fixed amount related to the total minutes allowed in your calling plan. The amount does not change when you use more or less allowed minutes.



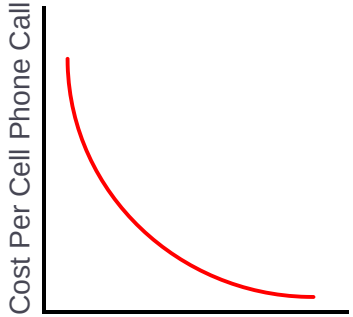
Types of Cost Behavior Patterns – Fixed

Average fixed costs per unit decrease as the activity level increases.

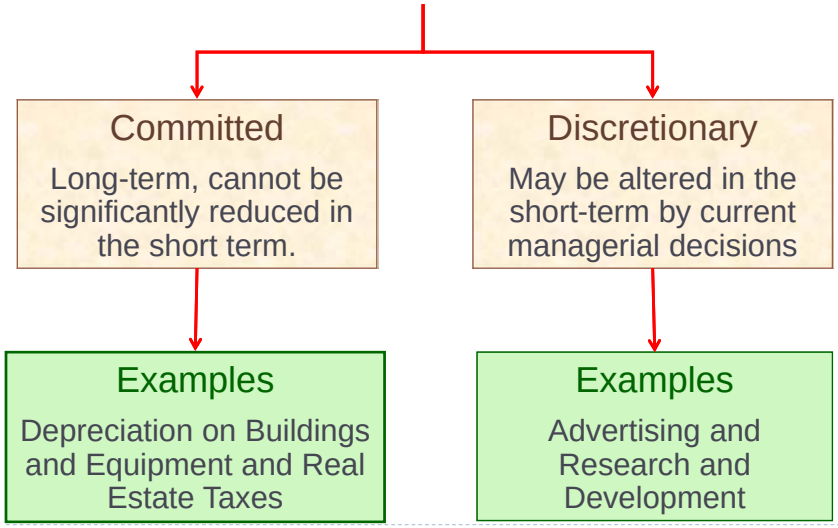
Cost	In Total	Per Unit
Variable	Total variable cost is proportional to the activity level within the relevant range.	Variable cost per unit remains the same over wide ranges of activity.
Fixed	Total fixed costs remain the same even when the activity level changes within the relevant range.	Average fixed costs per unit decrease as the activity level increases.

Fixed Cost Per Unit Example

For example, the fixed cost per minute used decreases as more allowed minutes are used.



Types of Fixed Costs



The Trend Toward Fixed Costs

The trend in many industries is toward *greater fixed costs* relative to variable costs.

As machines take over many mundane tasks previously performed by humans, "*knowledge workers*" are demanded for their minds rather than their muscles.

Knowledge workers tend to be salaried, highly-trained and difficult to replace. The cost of compensating these valued employees is *relatively fixed* rather than variable.

Is Labor a Variable or a Fixed Cost?

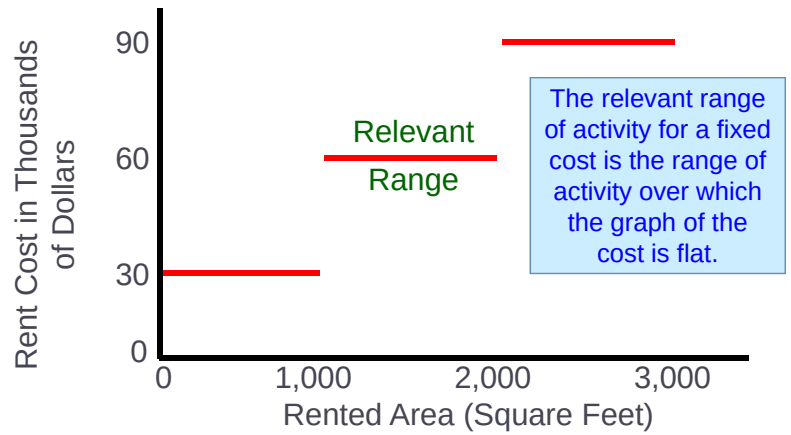
The behavior of wage and salary costs can *differ across countries*, depending on labor regulations, labor contracts, and custom.

In *France*, *Germany*, *China*, and *Japan*, management has little flexibility in adjusting the size of the labor force. Labor costs are more fixed in nature.

In the *United States* and the *United Kingdom*, management has greater latitude. Labor costs are more variable in nature.

Within countries managers can view labor costs differently depending upon their strategy. Most companies in the *United States* continue to view direct labor as a variable cost.

Fixed Costs and the Relevant Range



Fixed Costs and the Relevant Range

For example, assume office space is available at a rental rate of $30,000 per year in increments of 1,000 square feet.

Fixed costs would increase in a step fashion at a rate of $30,000 for each additional 1,000 square feet.

Fixed Costs and the Relevant Range

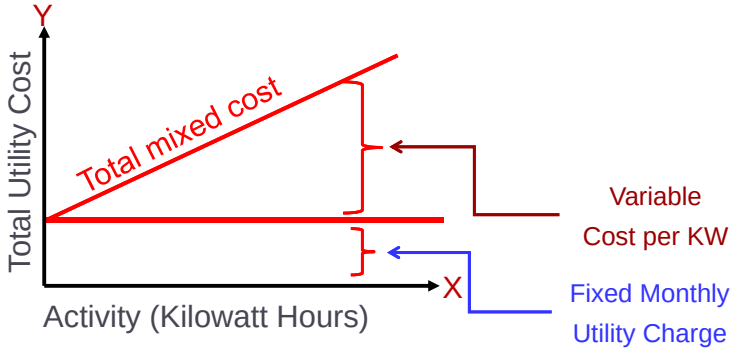
How does this step-function pattern differ from a step-variable cost?

Step-variable costs can be adjusted more quickly as conditions change and . . .

The width of the activity steps is much wider for the fixed cost.

Mixed Costs (also called semivariable costs)

A mixed cost contains both variable and fixed elements. Consider the example of utility cost.

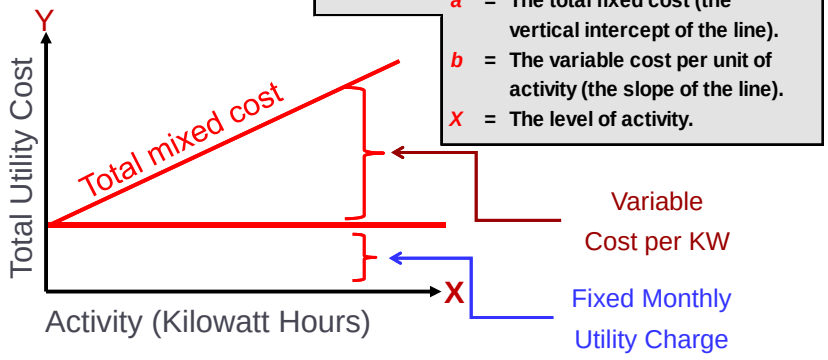


Mixed Costs

The total mixed cost line can be expressed as an equation: $Y = a + bX$

Where:

- Y = The total mixed cost.
- a = The total fixed cost (the vertical intercept of the line).
- b = The variable cost per unit of activity (the slope of the line).
- X = The level of activity.



Mixed Costs – An Example

If your fixed monthly utility charge is $40, your variable cost is $0.03 per kilowatt hour, and your monthly activity level is 2,000 kilowatt hours, what is the amount of your utility bill?

$$Y = a + bX$$

$$Y = \$40 + (\$0.03 \times 2{,}000)$$

$$Y = \$100$$

Objective 1: Understand how fixed and variable costs behave and how to use them to predict costs.

Analysis of Mixed Costs

Account Analysis and the Engineering Approach

In **account analysis**, each account is classified as either variable or fixed based on the analyst's knowledge of how the account behaves.

The **engineering approach** classifies costs based upon an industrial engineer's evaluation of production methods, and material, labor and overhead requirements.

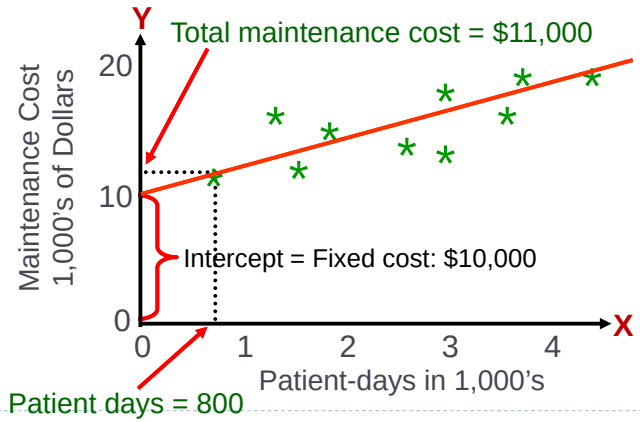
Why and how to reduce fixed costs or switch them to variable costs?

- Typical fixed costs: production facilities, rentals, employees salaries and related benefits and utilities
  - Converting them into variable may reduce risk of financial commitment and provide flexibility of capacity utilization
- **Outsourcing**
  - Business with fast and regular change and/or large varieties of products most likely will benefit from this approach (e.g. Nike and Apple)
  - Non-core business functions with lower value-add to majority customers (e.g. call centers for enquiries, 3rd party logistics, broker-dealers' securities back office operations)
- **Offshoring**
  - Honda and Toyota Thailand plants
  - HSBC back office functions in China

Objective 2: Use scattergraph plot to diagnose cost behavior.

The Scattergraph Method

1. Plot the data points on a graph (Total Cost ***Y*** vs. Activity ***X***).
2. Draw a line through the data points with about an equal number of points above and below the line.
3. Use one data point to estimate the total level of activity and the total cost.



Objective 2: Use scattergraph plot to diagnose cost behavior.

The Scattergraph Method

Make a quick estimate of variable cost per unit and determine the cost equation.

Total maintenance at 800 patients	$ 11,000
Less: Fixed cost	10,000
Estimated total variable cost for 800 patients	$ 1,000

Variable cost per unit = $\frac{\$1,000}{800}$ = $1.25/patient-day

$$Y = \$10,000 + \$1.25X$$

Total maintenance cost

Number of patient days

The High-Low Method – An Example

Assume the following hours of maintenance work and the total maintenance costs for six months.

High Low Method.xlsx

	Month	Hours of Maintenance	Total Maintenance Cost
2	January	625	$ 7,950
3	February	450	7,400
4	March	700	8,275
5	April	550	7,625
6	May	775	9,100
7	June	850	9,800

The High-Low Method – An Example

High Low Method.xlsx

	Month	Hours of Maintenance	Total Maintenance Cost
2	January	625	$ 7,950
3	February	450	7,400
4	March	700	8,275
5	April	550	7,625
6	May	775	9,100
7	June	850	9,800
8	High	850	$ 9,800
9	Low	450	7,400
10	Change	400	$ 2,400

The *variable cost per hour* of maintenance is equal to the change in cost divided by the change in hours.

$$\frac{\$2,400}{400} = \$6.00/\text{hour}$$

The High-Low Method – An Example

High Low Method.xlsx

	Month	Hours of Maintenance	Total Maintenance Cost
8	High	850	$ 9,800
9	Low	450	7,400
10	Change	400	$ 2,400

Total Fixed Cost = Total Cost – Total Variable Cost

Total Fixed Cost = $9,800 – ($6/hour × 850 hours)

Total Fixed Cost = $9,800 – $5,100

Total Fixed Cost = $4,700

The High-Low Method – An Example

High Low Method.xlsx

	Month	Hours of Maintenance	Total Maintenance Cost
8	High	850	$ 9,800
9	Low	450	7,400
10	Change	400	$ 2,400

The Cost Equation for Maintenance

$$Y = \$4,700 + \$6.00X$$

Least-Squares Regression Method

A method used to analyze mixed costs if a scattergraph plot reveals an approximately linear relationship between the *X* and *Y* variables.

This method uses *all* of the data points to estimate the fixed and variable cost components of a mixed cost.

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The goal of this method is to fit a straight line to the data that *minimizes the sum of the squared errors*.

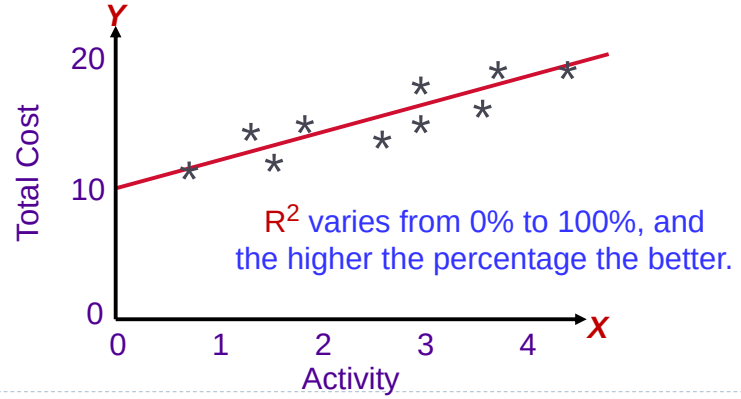
Least-Squares Regression Method

- Software can be used to fit a regression line through the data points.
- The cost analysis objective is the same: ***Y = a + bX***

Least-squares regression also provides a statistic, called the R^2, which is a measure of the goodness of fit of the regression line to the data points.

Least-Squares Regression Method

R^2 is the percentage of the variation in the dependent variable (total cost) that is explained by variation in the independent variable (activity).



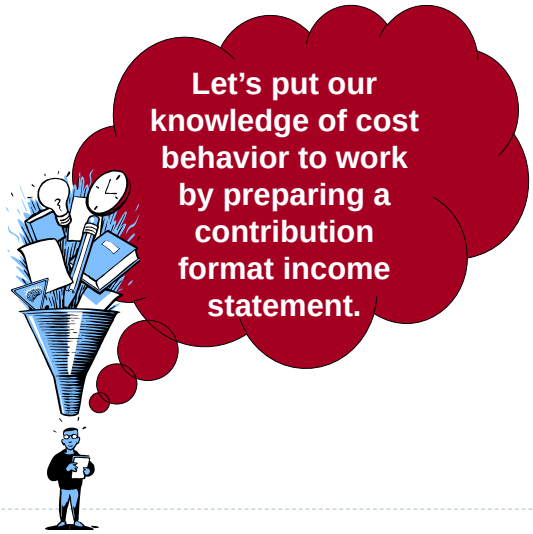
Comparing Results From the Three Methods

The three methods just discussed provide slightly different estimates of the fixed and variable cost components of the mixed cost.

This is to be expected because each method uses differing amounts of the data points to provide estimates.

Least-squares regression provides the most accurate estimate because it uses all the data points.

The Contribution Format



The Contribution Format

	Total	Unit
Sales Revenue	$100,000	$ 50
Less: Variable costs	60,000	30
Contribution margin	$ 40,000	$ 20
Less: Fixed costs	30,000	
Net operating income	$ 10,000	

The contribution margin format emphasizes cost behavior. Contribution margin covers fixed costs and provides for income.

Uses of the Contribution Format

The contribution income statement format is used as an internal planning and decision-making tool. We will use this approach for:

1. Cost-volume-profit analysis (Chapter 4).
2. Budgeting (Chapter 10).
3. Segmented reporting of profit data (Chapter 13).
4. Special decisions such as pricing and make-or-buy analysis (Chapter 14).

The Contribution Format

Comparison of the Contribution Income Statement with the Traditional Income Statement

Traditional Approach (costs organized by *function*)		Contribution Approach (costs organized by *behavior*)	
Sales	$100,000	Sales	$100,000
Less cost of goods sold	70,000	Less variable expenses	60,000
Gross margin	$ 30,000	Contribution margin	$ 40,000
Less operating expenses	20,000	Less fixed expenses	30,000
Net operating income	$ 10,000	Net operating income	$ 10,000

Used primarily for external reporting.

Used primarily by management.

Least-Squares Regression Computations

Appendix 3A

Simple Regression Analysis – An Example

Matrix, Inc. wants to know its average fixed cost and variable cost per unit.

Using the data to the right, let's see how to do a regression using Microsoft Excel.

	B	C	D
1			
2			
3	Month	Total Cost	Units (Meals)
4	January	$ 6,720	1,280
5	February	7,260	1,810
6	March	7,270	1,620
7	April	11,060	2,830
8	May	12,580	3,630
9	June	8,660	2,610
10	July	8,580	2,460
11	August	9,550	2,640
12	September	13,050	3,620
13	October	11,060	2,840
14	November	7,320	1,820
15	December	7,370	1,650
16	January	6,790	1,260
17	February	7,480	1,850
18	March	6,990	1,710
19	April	11,400	2,940

Simple Regression Using Excel – An Example

You will need three pieces of information from your regression analysis:

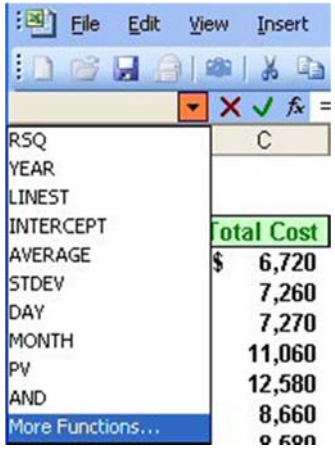
1. Estimated Variable Cost Per Unit (line slope)
2. Estimated Fixed Costs (line intercept)
3. Goodness of fit, or R^2

To get these three pieces information we will need to use *three* Excel functions.

SLOPE, INTERCEPT, and RSQ

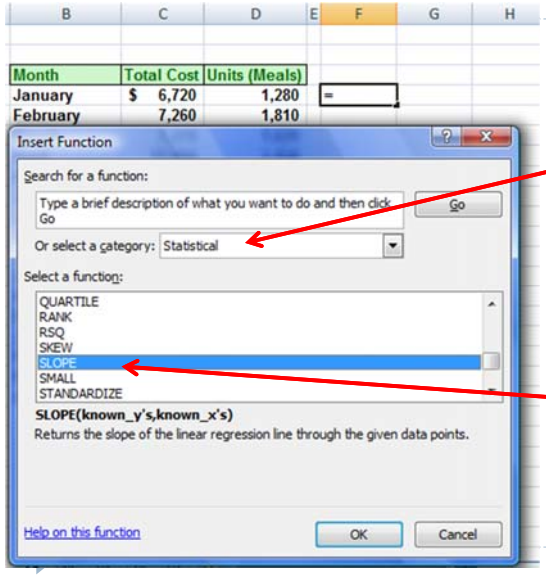
	B	C	D
1			
2			
3	Month	Total Cost	Units (Meals)
4	January	$ 6,720	1,280
5	February	7,260	1,810
6	March	7,270	1,620
7	April	11,060	2,830
8	May	12,580	3,630
9	June	8,660	2,610
10	July	8,580	2,460
11	August	9,550	2,640
12	September	13,050	3,620
13	October	11,060	2,840
14	November	7,320	1,820
15	December	7,370	1,650
16	January	6,790	1,260
17	February	7,480	1,850
18	March	6,990	1,710
19	April	11,400	2,940

Simple Regression Using Excel – An Example



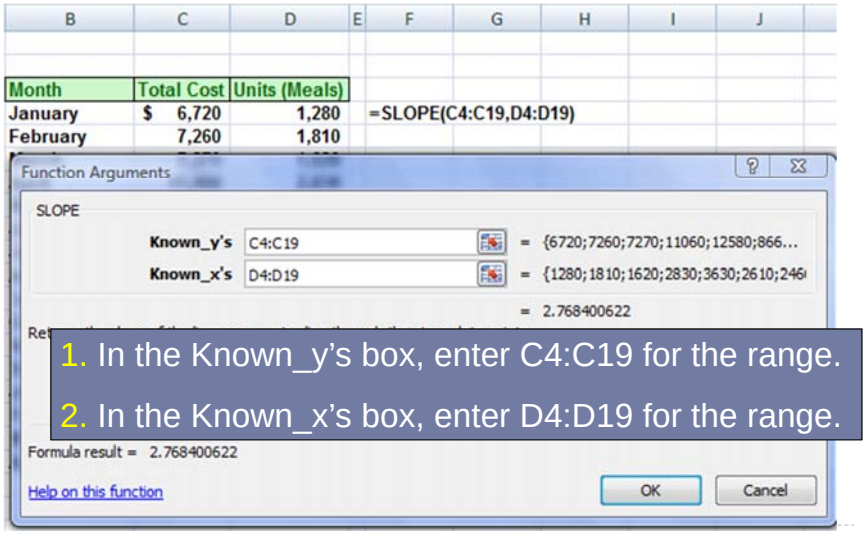
Place your cursor in cell F4 and press the = key. Click on the pull down menu and scroll down to "More Functions . . ."

Simple Regression Using Excel – An Example



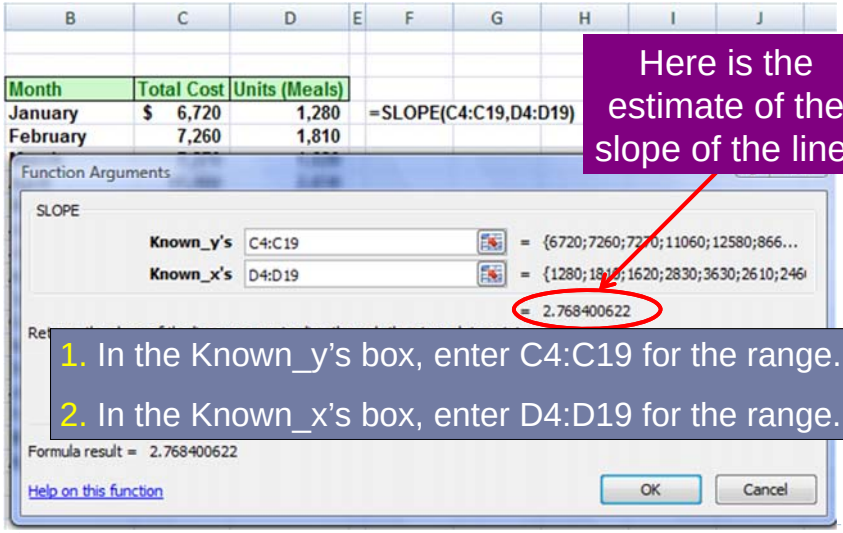
Scroll down to the "Statistical", functions. Now scroll down the statistical functions until you highlight "SLOPE"

Simple Regression Using Excel – An Example



1. In the Known_y's box, enter C4:C19 for the range.
2. In the Known_x's box, enter D4:D19 for the range.

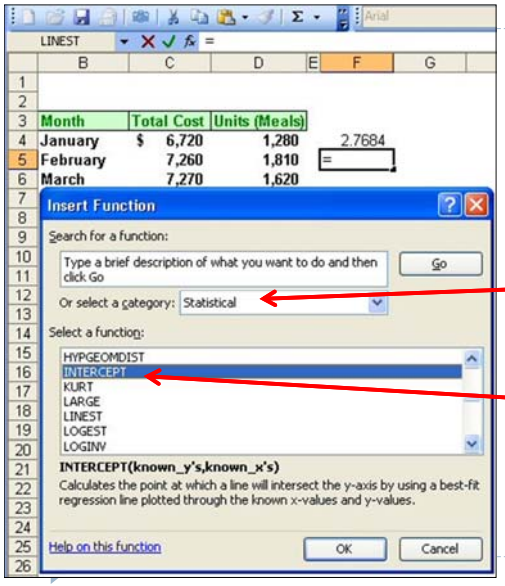
Simple Regression Using Excel – An Example



Here is the estimate of the slope of the line.

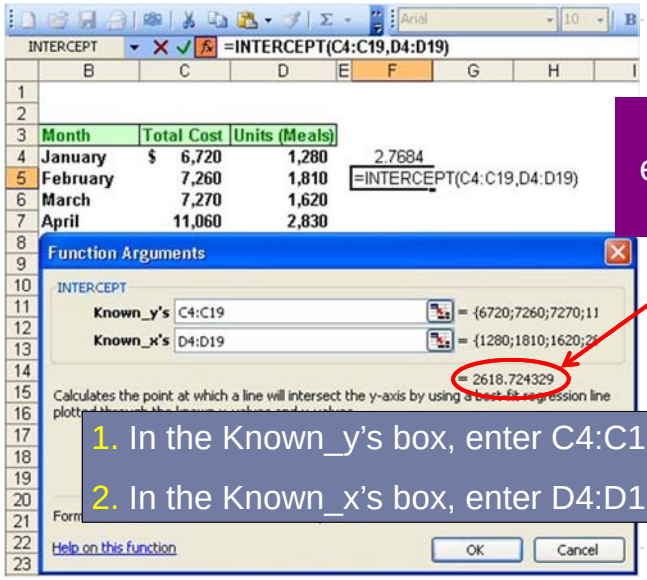
1. In the Known_y's box, enter C4:C19 for the range.
2. In the Known_x's box, enter D4:D19 for the range.

Simple Regression Using Excel – An Example



With your cursor in cell F5, press the = key and go to the pull down menu for "Special Functions." Select Statistical and scroll down to highlight the INTERCEPT function.

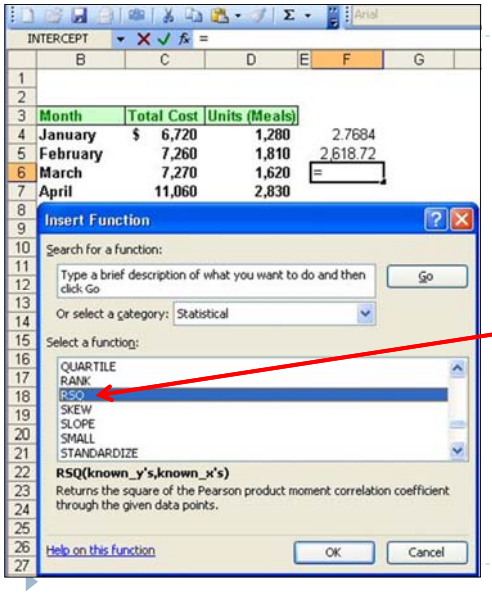
Simple Regression Using Excel – An Example



Here is the estimate of the fixed costs.

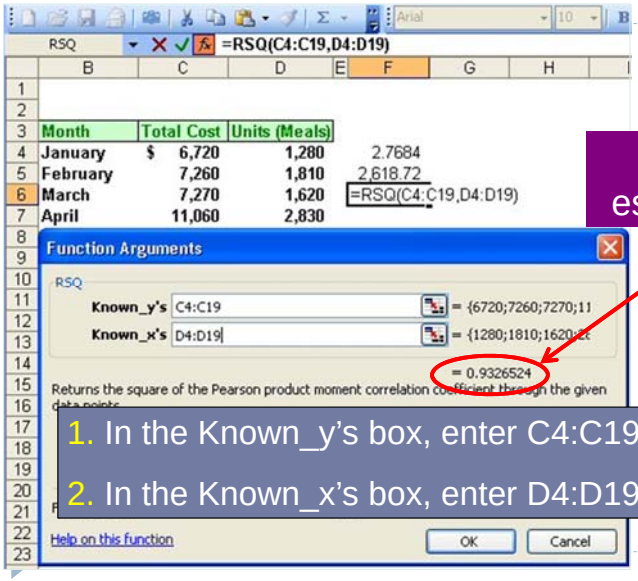
1. In the Known_y's box, enter C4:C19 for the range.
2. In the Known_x's box, enter D4:D19 for the range.

Simple Regression Using Excel – An Example



Finally, we will determine the "*goodness of fit*", or R^2, by using the *RSQ* function.

Simple Regression Using Excel – An Example



Here is the estimate of R^2.

1. In the Known_y's box, enter C4:C19 for the range.
2. In the Known_x's box, enter D4:D19 for the range.

End of Chapter 3